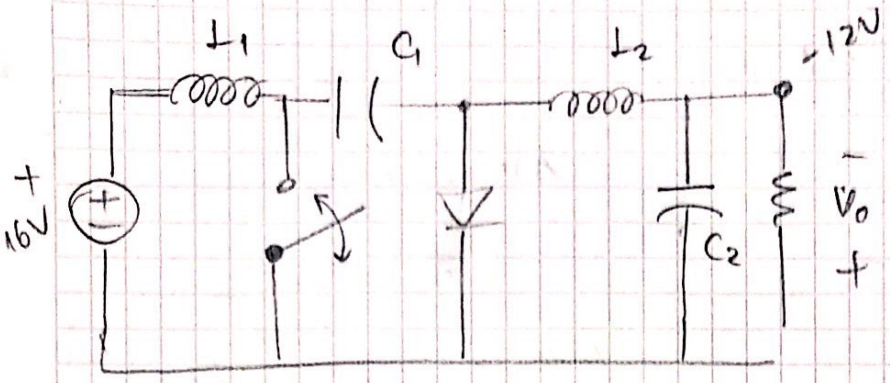
Q2| Cuk Converter

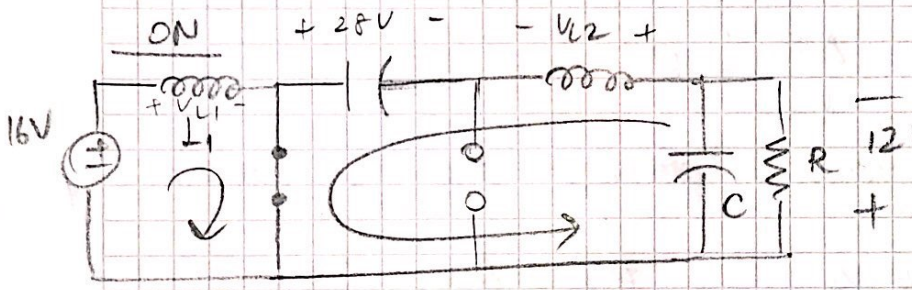


a) Find C_2 by assuming 2% ripple and L_1 and L_2 by assuming 10% ripple.

once again, $\frac{V_o}{V_d} = \frac{D}{1-D}$, so the duty remains identical.

$24W = 16\, i_{in\,ave} = 12\, i_{out\,ave}$

$$\begin{cases} i_{in\,ave} = \frac{3}{2} A \\ i_{out\,ave} = 2A \end{cases}$$



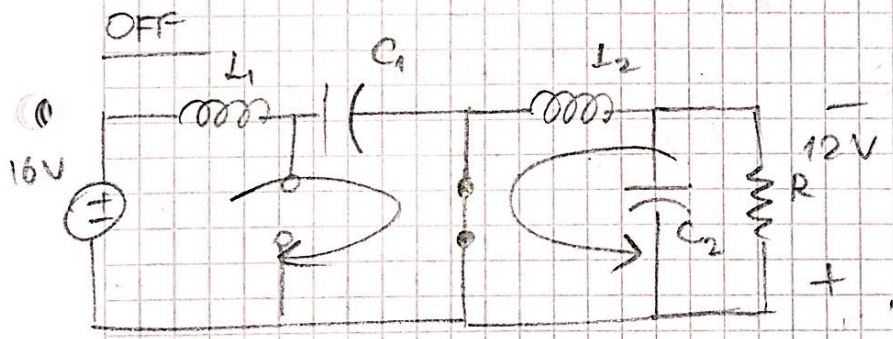
L_2/ this inductor will see a voltage of +16V.

$$\Delta i_{L_2} = \frac{16V \cdot 3}{7 \cdot 50kHz \cdot L_2}$$

$$\frac{\Delta i_{L_2}}{i_{L_2}} = \frac{48}{350k \cdot L_2 \cdot 2} = \frac{1}{10}$$

$$L_2 = \frac{240}{350k}$$

$$L_2 \cong 0,686 mH$$



L_1/ this inductor will see a voltage of +16V during the on cycle.

$$\Delta i_{L_1} = \frac{16V \cdot 3}{7 \cdot 50kHz\, L}$$

$$\frac{\Delta i_{L_1}}{i_{L_1}} = 0,1 \Rightarrow \frac{48V}{350k \cdot L_1 \cdot \frac{3}{2}} = \frac{1}{10}$$

$$\frac{320}{350k} = L_1$$

$$L_1 \cong 0,914 mH$$

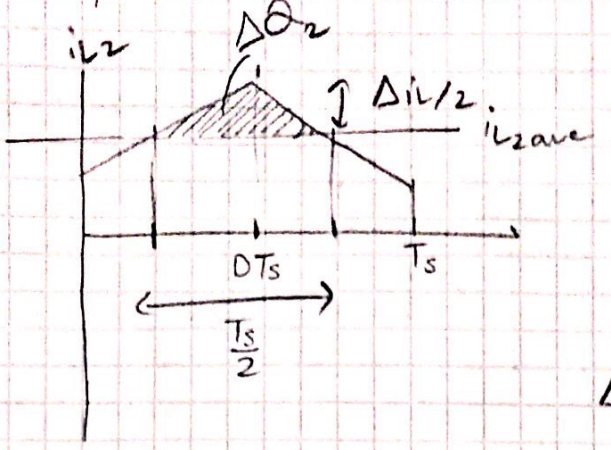
> verify in the discharge cycle:

$$\Delta i_{L_1} = \frac{(16-28) \cdot 4}{7 \cdot 50kHz\, L_1}$$

$$\cong 0,1500 V \qquad L_1 = 0,914 mH$$

Scanned with CamScanner

We can find the V_{C2} ripple by considering the L_2 wave form.



$$\Delta Q_2 = \frac{\Delta i_{L2}}{2} \cdot \frac{T_S}{2} \cdot \frac{1}{2}$$

$$\Delta V_0 = \frac{\Delta Q_2}{C} = \frac{\Delta i_{L_2} T_S}{8 C_2}$$

$$\Delta V_0 = \frac{(1-D)\,T_S\,(-V_0)\,T_S}{8 L_2 C_2}$$

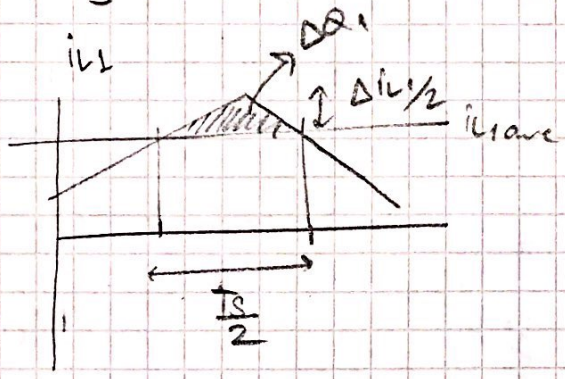
$$\left|\frac{\Delta V_0}{V_0}\right| = \frac{(1-D)\,T_S^2}{8 L_2 C_2} = 0{,}02$$

$$\frac{4 \cdot 1000}{7 \cdot (50k)^2 \, 8 \cdot 0{,}686 \cdot C_2} = 0{,}02$$

$$\rightarrow C_2 \cong 2.082\ \mu F$$

b) Find C_1 if $\frac{\Delta V_{C1}}{V_{C1}} = 0{,}1$

During the off cycle, L_1 discharges and C_1 charges.



$$\Delta Q_1 = \frac{\Delta i_{L_1}}{2} \cdot \frac{T_S}{2} \cdot \frac{1}{2} = \frac{\Delta i_{L_1} T_S}{8}$$

$$\Delta V_{C1} = \frac{\Delta Q_1}{C} = \frac{(1-D)(-12)\,T_S \cdot T_S}{8 L_1 C_1}$$

$$0{,}1 = \left|\frac{\Delta V_{C1}}{V_{C1}}\right| = \frac{4 \cdot 12 \cdot 1000}{7 \cdot 8 \cdot 0{,}914 \cdot C_1 \cdot (50k)^2 \cdot 28}$$

$$\Rightarrow C_1 = \frac{480 \cdot 1000}{56 \cdot 0{,}914 \cdot (50k)^2 \cdot 28}$$

$$\cong 0{,}134\ \mu F$$

Scanned with CamScanner